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To: Mr. I.J. Stuart-Sheppard
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H11A17

TURBINE PERFORMANCE ACCEPTANCE TEST ATIKOKAN TGS, UNIT 1

D.F. Townshend

The Electrical Research Department assisted the Performance Test Group, Design and Development Division, by measuring various generator electrical quantities during a turbine performance acceptance test series on Unit 1, Atikokan Generating Station, November 14-21, 1985. This report describes the electrical instrumentation procedures and contains the final tabulated electrical results of these tests corrected for all metering errors.

1.0 INSTRUMENTATION

1.1 Quantities Measured

Generator Power
Generator Reactive Power
Generator Phase Currents
Generator Phase to Neutral Voltages
AC Power Supplied to the Excitation Transformer
Station Service Load

Generator operating power factor was determined from the measurements of generator power and reactive power.

1.2 Metering Transformers

The unit metering current transformer name plate data is: 10 000/5/5 A, accuracy class 0.3 B1.8, Brown Boveri. These transformers were calibrated, including the test winding, at the Research Division facilities prior to installation at site. The results of these calibrations are contained in instrument transformer accuracy records EC83-263-K, EC83-264-K, EC83-265-K, copies of which are attached. In March 1985 these transformer

job	file	date	report no.
740618-179-472	813.111	March 13, 1986	86-31-K

calibrations were checked on site with the aid of the test winding to ensure the validity of the original calibrations. The results of this check is contained in instrument transformer accuracy record EC85-82-K, a copy of which is attached. Transformer burden measurements were made of the normal station metering to calculate a transformer correction factor for application to measured electrical quantities.

Prior to the performance test special potential instrument transformers, CGE type E235Y, Serial Numbers 530307, 530308, 530309, were installed in parallel with unit metering potential transformers. Calibration data are contained in reports EC84-299-K, EC84-300-K, EC84-301-K, copies of which are attached. The secondaries of these special instrument transformers were connected to a "test metering panel" to supply the potential coils of acceptance test metering exclusively.

1.3 Transformer Correction Factor

The staff of the Standards Laboratory of the Electronics and Instrumentation Section, Electrical Research Department, responsible for providing the calibrations for unit metering current transformers and the special potential transformers have calculated the combined transformer correction factors applicable to station metering burdens and additional test metering burdens over the range of unit loading. A copy of this calibration record EC85-483-K is attached. This transformer correction factor is directly applicable only to the three-phase, three element power measurements made during the test series.

1.4 Generator Power

Generator power was measured with a scientific columbus three-phase four-wire digilogic watt/watthour transducer programmed for integrated power monitoring over repetitive five-minute periods during the test period. This transducer produces a train of pulses proportional in number to power input which, together with a precision counter and programmable timer, provides a highly accurate measure of electrical power integrated over a selected period of time. The quality and accuracy of this instrument is such that the staff of our standards laboratory use it as a transfer calibration standard in transferring watt/watthour calibration standards from the National Bureau of Standards to the Research Division. This solid-state device, in laboratory calibrations, has consistently shown a percent registration of 100.1 or better which is well within the 0.25% accuracy class required by the power test code for steam turbines in measurements of generator power. In calculating generator power the following equation is used:

$$\text{Generator Power in Watts} = \frac{\text{pulse count} \times \text{REC C.F.} \times M \times N \times \text{T.F.C.} \times 60}{512 \times \text{time (minutes)}}$$

where

pulse count = counts on watt/watthour transducer

REG.C.F. = watt/watthour transducer calibration (100%)/(% registration)

M = potential transformer nominal ratio

N = current transformer nominal ratio

T.C.F. = combined transformer correction factor of rated and phase angle

Time = pulse count time duration in minutes

60 = time constant

512 = watt/watthour transducer constant

1.5 Generator Reactive Power

Generator reactive power is not directly measureable, it must be derived. In this test series, reactive power measurements were determined by using an identical transducer as that used in the measurement of generator electrical power and phase shifting the phase to neutral voltages through 90 electrical degrees before application to the transducer.

1.6 Generator Operating Power Factor

The operating power factor is determined from the measurement of generator power and reactive power.

$$\text{Power Factor angle } \theta = \tan^{-1}\left(\frac{\text{generator reactive power}}{\text{generator power}}\right)$$

$$\text{Power Factor} = \cos\theta$$

1.7 Phase Currents and Phase Voltages

Three phase currents and phase to neutral voltages were measured during each test series using portable standard quality meters calibrated to an estimated accuracy of $\pm 0.1\%$. These quantities were required to verify relatively constant and balanced load conditions and establish levels of current and voltage for watt/watthour meter calibrations.

1.8 Input Power to Excitation Transformer

This unit is equipped with a static exciter supplied from the 4160 Volt "B" bus. To measure exciter input power to the excitation transformer a scientific columbus digilogic watt/watthour transducer was used, identical to that used in measuring generator power. The transducer was programmed for integrated power monitoring over repetitive five-minute periods coincident with generator power monitoring. Current and potential quantities were supplied from station current and potential transformers. Portable standard accuracy class ammeters, voltmeters and a polyphase wattmeter were installed and recorded periodically to establish levels of current, voltage, and power factor for watt/watthour transducer calibrations.

1.9 Station Service Load

Station service load was measured during some of the tests using a scientific columbus digilogic watt/watthour transducer, identical to that used in measuring generator power, and programmed for integrated power monitoring over repetitive five-minute periods coincident with generator power monitoring. Currents and voltages were supplied from station current and voltage transformers.

2.0 ACCURACY OF TEST RESULTS

2.1 Generator Power

To derive the true generator power, three factors must be considered, namely; the percent registration of the watt/watthour transducer, the transformer correction factor of the metering transformers, and the number of pulse counts during the time period of integration of the power measurement.

The attached watt/watthour transducer (Lab No 3788) percent registration calibration report EC85-418-K (before test series) and report EC85-485-K (after test series) shows no appreciable difference in registration indicating these calibrations are valid throughout the test series with an estimated accuracy of $\pm 0.1\%$.

A combined transformer correction factor, as supplied by the staff of the Standards Laboratory, indicates an estimated accuracy of ± 0.0010, a copy of report EC85-483 is attached.

The digilogic watt/watthour transducer was programmed for integrated power monitoring over repetitive five-minute periods. A total pulse count of 30 000 to 50 000 pulses, dependent on

generator loading, accurate to ±1 count, was recorded over this elapsed time which could result in an error so small that it can be neglected.

From the above, the combined outside limits of error for generator power measurement is therefore ±0.2% or ±471 kW at a gross electrical power output of 235 726 kW.

If the root mean square method of establishing possible errors is used, the test results for gross power output are deemed to be accurate to within ±0.14% or 330 kW at a gross electrical power output of 235 726 kW.

2.2 Generator Reactive Power

Generator reactive power measurements are a derived quantity requiring the use of phase shifting transformers and as such transformer correction factors for the metering transformers, as listed elsewhere in this report, are not applicable to this measurement. The attached instrument percent registration calibration report no EC85-416-K (before test series) and report no EC85-484-K (after test series) show no appreciable difference in calibration registration which indicates these calibrations are valid throughout the test series to an estimated accuracy of ±0.1%.

2.3 Generator Operating Power Factor

Generator operating power factor is obtained from measurements of generator power and reactive power. As noted previously the outside limits of error for generator power is ±0.2%. The limits of error for generator reactive power are less definite due to the omission of an applicable metering transformer correction factor for this quantity. However, with a unit operating power factor of 0.85, it would require a combined metering error of ±4% to produce an error of ±1% in power factor measurement. Therefore the error in neglecting a TCF factor in computing generator reactive power is small and can be neglected if we assume the estimated outside limits of error for generator operating power factor is ±1.0%.

2.4 Input Power to Excitation Transformer

The estimated accuracy of percentage registration calibration of the digilogic watt/watthour transducer at the measured power factor range of 0.3 to 0.5 is ±0.25% as listed in the appended calibration report EC85-428-K (before test series) and report EC85-486-K (after test series). However, current and potential quantities used in this measurement were supplied from station metering current and potential transformers, accuracy class 2.5 L 100 and 0.6Z 200 VA, respectively, of which there is no trans-

former correction factor. From turbine performance test No 6, four control values full open and an operating power factor of 0.85, average exciter power is 651 kW which represents about 0.28% of gross power output of 229 989 kW. Therefore any errors in instrumentation calibrations, although unknown, can be considered to have an insignificant affect in calculating net generator power output and have been omitted.

2.5 Station Service Load

The estimated accuracy of percentage registration calibration of the digilogic watt/watthour transducer used in measuring station service load is ±0.1% as shown in the appended instrument calibration report No EC85-427-K. However, current and potential quantities were supplied from station metering transformers of which there is no transformer correction factor. Therefore no accuracy limits are available for station service load measurements.

3.0 TEST RESULTS

There were ten tests in the series and the results are presented in the appended tables, listing dates and times, repetitive five-minute test results, and averages over the full test period. Also appended are relevant instrument calibration reports.

The tabled values for generator power should be considered correct to within the outside limits of error of ±0.2%, as listed in Section 2.1 of this report.

Approved:

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DFT:djb

ATIKOKAN TGS UNIT 1
TURBINE PERFORMANCE TEST NO 1
FOUR CONTROL VALVES FULL OPEN

GENERATOR OUTPUT

Date Nov 14-1985 Time Period	Gen. Output Gross kW	Gen. Output Gross kVars	Gen. Output Net kW	Power Factor Lagging	Exciter Input kW	Station Service kW
11:30 - 11:35	235 500	91 357	234 984	0.9213	516	15 824
11:35 - 11:40	236 064	90 344	235 547	0.9213	517	15 791
11:40 - 11:45	235 604	83 282	235 107	0.9428	497	15 761
11:45 - 11:50	235 912	84 160	235 414	0.9419	498	15 778
11:50 - 11:55	236 540	79 559	236 052	0.9478	488	15 785
11:55 - 12:00	235 102	77 009	234 623	0.9503	479	15 746
12:00 - 12:05	235 152	77 055	234 672	0.9503	480	15 720
12:05 - 12:10	234 455	76 865	233 978	0.9502	477	15 720
12:10 - 12:15	235 308	75 202	234 833	0.9525	475	15 739
12:15 - 12:20	234 537	77 760	234 057	0.9492	480	15 706
12:20 - 12:25	234 709	75 325	234 235	0.9522	474	15 733
12:25 - 12:30	235 119	76 422	234 640	0.9510	479	15 747
12:30 - 12:35	236 414	76 118	235 934	0.9518	480	15 751
12:35 - 12:40	237 987	77 823	237 500	0.9504	487	15 787
12:40 - 12:45	237 021	75 785	236 542	0.9525	479	15 799
12:45 - 12:50	235 882	75 400	235 406	0.9525	476	15 777
12:50 - 12:55	235 249	76 502	234 772	0.9509	477	15 785
12:55 - 13:00	233 031	77 249	232 558	0.9492	473	15 776
13:00 - 13:05	234 537	70 377	234 074	0.9578	463	15 725
13:05 - 13:10	235 612	70 947	235 146	0.9575	466	15 734
13:10 - 13:15	234 503	70 297	234 039	0.9579	464	15 710
13:15 - 13:20	234 562	74 649	234 090	0.9529	472	15 693
13:20 - 13:25	233 119	75 198	232 650	0.9517	469	15 677
13:25 - 13:30	232 086	78 930	231 607	0.9467	479	15 672
Average	235 167	77 651	234 686	0.9484	481	15 747

ATIKOKAN TGS UNIT 1
TURBINE PERFORMANCE TEST NO 2
FOUR CONTROL VALVES FULL OPEN

GENERATOR OUTPUT

Date Nov 15-1985 Time Period	Gen. Output Gross kW	Gen. Output Gross kVars	Gen. Output Net kW	Power Factor Lagging	Exciter Input kW	Station Service kW
20:00 - 20:05	237 751	81 006	237 257	0.9466	494	
20:05 - 20:10	237 215	82 345	236 719	0.9477	496	
20:10 - 20:15	239 273	83 792	238 769	0.9438	504	
20:25 - 20:30	236 388	76 304	235 906	0.9516	482	
20:30 - 20:35	237 270	77 439	236 787	0.9506	483	
20:35 - 20:40	237 784	79 601	237 294	0.9483	490	
20:40 - 20:45	237 552	80 154	237 059	0.9475	493	
20:45 - 20:50	236 253	79 976	235 765	0.9472	488	
20:50 - 20:55	237 228	80 082	236 738	0.9475	490	
20:55 - 21:00	238 261	82 923	237 768	0.9444	493	
21:00 - 21:05	238 889	82 480	238 390	0.9452	499	
21:40 - 21:45	233 453	82 247	232 966	0.9432	487	
21:45 - 21:50	235 152	81 319	234 663	0.9451	489	
21:50 - 21:55	236 144	80 589	235 655	0.9464	489	
21:55 - 22:00	236 139	78 917	235 653	0.9484	486	
22:00 - 22:05	232 955	78 267	232 476	0.9479	479	
22:05 - 22:10	232 217	75 519	231 746	0.9510	471	
22:10 - 22:15	232 466	74 666	231 998	0.9521	468	
22:15 - 22:20	231 951	74 603	231 484	0.9520	467	
22:20 - 22:25	233 579	75 080	233 109	0.9520	470	
22:25 - 22:30	232 318	73 058	231 851	0.9539	467	
Average	235 726	79 065	235 241	0.9482	485	

ATIKOKAN TGS UNIT 1
TURBINE PERFORMANCE TEST NO 4
THREE CONTROL VALVES FULL OPEN

GENERATOR OUTPUT

Date Nov 14-1985 Time Period	Gen. Output Gross kW	Gen. Output Gross kVars	Gen. Output Net kW	Power Factor Lagging	Exciter Input kW	Station Service kW
19:00 - 19:05	207 695	137 820	207 089	0.8332	606	14 913
19:05 - 19:10	209 246	138 808	208 632	0.8333	614	14 946
19:10 - 19:15	210 941	138 280	210 327	0.8363	614	14 987
19:15 - 19:20	212 160	138 306	211 542	0.8377	618	15 045
19:20 - 19:25	213 138	138 394	212 517	0.8387	621	15 116
19:25 - 19:30	213 931	136 947	213 314	0.8422	617	15 148
19:30 - 19:35	213 155	137 137	212 539	0.8410	616	15 124
19:35 - 19:40	212 059	134 630	211 451	0.8442	608	15 076
19:40 - 19:45	211 603	134 698	210 996	0.8436	607	14 995
19:45 - 19:50	212 788	134 061	212 184	0.8461	604	15 008
19:50 - 19:55	214 492	135 103	213 879	0.8461	613	15 047
19:55 - 20:00	214 947	136 698	214 329	0.8438	618	15 105
20:00 - 20:05	214 467	135 411	213 852	0.8455	615	15 105
20:05 - 20:10	212 426	136 002	211 812	0.8422	614	15 057
20:10 - 20:15	211 203	134 208	210 601	0.8440	602	14 959
20:15 - 20:20	211 388	135 158	210 784	0.8425	604	14 952
20:20 - 20:25	212 742	134 225	212 136	0.8457	606	14 950
20:25 - 20:30	213 041	134 820	212 438	0.8450	603	14 981
20:30 - 20:35	212 772	133 955	212 172	0.8462	600	14 991
20:35 - 20:40	212 173	133 656	211 576	0.8461	597	15 010
20:40 - 20:45	211 633	135 234	211 033	0.8426	600	14 967
20:45 - 20:50	210 646	134 862	210 046	0.8422	600	14 967
20:50 - 20:55	210 929	134 225	210 329	0.8436	600	14 957
20:55 - 21:00	210 625	137 006	210 018	0.8382	607	14 997
Average	212 092	135 818	211 483	0.8421	608	14 454

ATIKOKAN TGS UNIT 1
TURBINE PERFORMANCE TEST NO 6
FOUR CONTROL VALVES FULL OPEN

GENERATOR OUTPUT

Date Nov 21-1985 Time Period	Gen. Output Gross kW	Gen. Output Gross kVars	Gen. Output Net kW	Power Factor Lagging	Exciter Input kW	Station Service kW
10:00 - 10:05	230 762	139 813	230 105	0.8553	657	
10:05 - 10:10	230 441	139 526	229 786	0.8554	655	
10:10 - 10:15	229 880	139 569	229 226	0.8548	654	
10:15 - 10:20	229 754	139 830	229 099	0.8542	655	
10:20 - 10:25	230 365	139 548	229 710	0.8553	655	
10:25 - 10:30	230 791	139 506	230 135	0.8558	656	
10:30 - 10:35	229 729	139 611	229 076	0.8546	653	
10:35 - 10:40	230 770	139 421	230 115	0.8559	655	
10:40 - 10:45	229 885	139 227	229 232	0.8554	653	
10:45 - 10:50	229 615	138 957	228 963	0.8555	652	
10:50 - 10:55	229 788	138 653	229 137	0.8562	651	
10:55 - 11:00	229 931	138 104	229 282	0.8573	649	
11:00 - 11:05	230 635	138 290	229 983	0.8576	652	
11:05 - 11:10	230 260	137 935	229 611	0.8579	649	
11:10 - 11:15	230 644	138 121	229 997	0.8579	647	
11:15 - 11:20	229 682	138 459	229 037	0.8564	645	
11:20 - 11:25	229 471	138 417	228 824	0.8563	647	
11:25 - 11:30	229 842	138 421	229 194	0.8566	648	
11:30 - 11:35	230 505	139 210	229 856	0.8560	649	
11:35 - 11:40	230 424	138 872	229 772	0.8565	652	
11:40 - 11:45	229 585	138 454	228 936	0.8563	649	
11:45 - 11:50	229 412	138 509	228 763	0.8561	649	
11:50 - 11:55	228 738	138 712	228 091	0.8551	647	
11:55 - 12:00	228 835	138 560	228 188	0.8554	647	
Average	229 989	138 905	229 338	0.8560	651	

ATIKOKAN TGS UNIT 1
TURBINE PERFORMANCE TEST NO 7
THREE CONTROL VALVES FULL OPEN

GENERATOR OUTPUT

Date Nov 18-1985 Time Period	Gen. Output Gross kW	Gen. Output Gross kVars	Gen. Output Net kW	Power Factor Lagging	Exciter Input kW	Station Service kW
23:30 - 23:35	213 645	124 997	213 077	0.8631	568	
23:35 - 23:40	214 214	125 064	213 646	0.8636	568	
23:40 - 23:45	213 784	127 288	213 208	0.8592	576	
23:45 - 23:50	213 025	127 672	212 450	0.8577	575	
23:50 - 23:55	213 371	129 998	212 798	0.8540	582	
23:55 - 00:00	214 168	126 567	213 590	0.8609	578	
00:00 - 00:05	213 978	119 540	213 422	0.8730	556	
00:05 - 00:10	213 434	115 595	212 893	0.8793	541	
00:10 - 00:15	216 799	115 785	216 253	0.8821	546	
00:15 - 00:20	216 154	115 582	215 609	0.8818	545	
00:20 - 00:25	214 492	115 818	213 949	0.8799	543	
00:25 - 00:30	213 303	114 789	212 766	0.8806	537	
00:30 - 00:35	212 936	114 253	212 402	0.8812	534	
00:35 - 00:40	212 207	114 113	211 675	0.8807	532	
00:40 - 00:45	212 751	113 767	212 224	0.8818	527	
00:45 - 00:50	213 687	114 278	213 152	0.8818	535	
00:50 - 00:55	213 720	114 633	213 184	0.8812	536	
00:55 - 01:00	213 636	113 172	213 104	0.8837	532	
01:00 - 01:05	213 606	112 299	213 077	0.8851	529	
01:05 - 01:10	214 227	112 641	213 696	0.8851	531	
01:10 - 01:15	215 104	112 354	214 572	0.8864	532	
01:15 - 01:20	216 470	113 143	215 933	0.8862	537	
01:20 - 01:25	217 179	113 341	216 640	0.8865	539	
01:25 - 01:30	216 272	112 978	215 735	0.8863	537	
Average	214 257	117 486	213 710	0.8777	546	

ATIKOKAN TGS UNIT 1
TURBINE PERFORMANCE TEST NO 8
TWO CONTROL VALVES FULL OPEN

GENERATOR OUTPUT

Date Nov 15-1985 Time Period	Gen. Output Gross kW	Gen. Output Gross kVars	Gen. Output Net kW	Power Factor Lagging	Excit- Input kW	Station Service kW
13:00 - 13:05	141 633	45 978	141 370	0.9511	263	12 688
13:05 - 13:10	140 237	43 070	139 981	0.9559	256	12 691
13:10 - 13:15	139 967	42 926	139 714	0.9560	253	12 672
13:15 - 13:20	140 954	42 086	140 700	0.9582	254	12 676
13:20 - 13:25	141 346	43 078	141 090	0.9566	256	12 664
13:25 - 13:30	142 890	42 437	142 634	0.9586	256	12 703
13:30 - 13:35	143 797	42 293	143 539	0.9594	258	12 680
13:35 - 13:40	144 493	40 313	144 237	0.9632	256	12 689
13:40 - 13:45	142 995	41 981	142 738	0.9595	257	12 673
13:45 - 13:50	140 798	41 681	140 546	0.9589	252	12 631
13:50 - 13:55	139 971	41 820	139 718	0.9581	253	12 635
13:55 - 14:00	142 072	41 052	141 818	0.9607	254	12 627
14:00 - 14:05	145 648	42 415	145 388	0.9601	260	12 693
14:05 - 14:10	145 522	42 086	145 263	0.9606	259	12 685
14:10 - 14:15	143 244	42 057	142 986	0.9595	258	12 697
14:15 - 14:20	140 891	42 947	140 634	0.9565	257	12 710
14:20 - 14:25	140 165	35 282	139 919	0.9697	246	12 689
14:25 - 14:30	143 995	12 584	143 776	0.9962	219	12 621
Average	142 257	40 338	142 003	0.9610	254	12 674

ATIKOKAN TGS UNIT 1
TURBINE PERFORMANCE TEST NO 8 - RUN 2
TWO CONTROL VALVES FULL OPEN

GENERATOR OUTPUT

Date Nov 20-1985 Time Period	Gen. Output Gross kW	Gen. Output Gross kVars	Gen. Output Net kW	Power Factor Lagging	Exciter Input kW	Station Service kW
14:30 - 14:35	146 241	80 404	145 903	0.8763	338	
14:35 - 14:40	146 026	80 860	145 686	0.8748	340	
14:40 - 14:45	145 866	80 624	145 527	0.8752	339	
14:45 - 14:50	145 318	80 687	144 980	0.8743	338	
14:50 - 14:55	143 998	81 117	143 661	0.8713	337	
14:55 - 15:00	144 420	80 607	144 083	0.8732	337	
15:00 - 15:05	144 049	80 362	143 713	0.8733	336	
15:05 - 15:10	144 378	80 147	144 042	0.8743	336	
15:10 - 15:15	144 382	80 320	144 046	0.8739	336	
15:15 - 15:20	144 542	80 915	144 205	0.8726	337	
15:20 - 15:25	144 884	80 615	144 547	0.8738	337	
15:25 - 15:30	144 791	80 050	144 455	0.8752	336	
15:30 - 15:35	144 378	79 788	144 044	0.8754	334	
15:35 - 15:40	144 289	80 252	143 956	0.8739	333	
15:40 - 15:45	144 690	80 164	144 356	0.8747	334	
15:45 - 15:50	144 335	80 531	144 000	0.8733	335	
15:50 - 15:55	144 302	80 691	143 966	0.8728	336	
15:55 - 16:00	144 188	80 666	143 852	0.8727	336	
16:00 - 16:05	144 217	80 759	143 881	0.8725	336	
16:05 - 16:10	143 960	81 282	143 623	0.8708	337	
16:10 - 16:15	144 104	81 147	143 767	0.8713	337	
16:15 - 16:20	143 969	81 096	143 632	0.8713	337	
16:20 - 16:25	144 150	80 881	143 813	0.8721	337	
16:25 - 16:30	144 057	79 936	143 722	0.8744	335	
Average	144 564	80 579	144 227	0.8735	336	

ATIKOKAN TGS UNIT 1
TURBINE PERFORMANCE TEST NO 9
118 MW

GENERATOR OUTPUT

Date Nov 18-1985 Time Period	Gen. Output Gross kW	Gen. Output Gross kVars	Gen. Output Net kW	Power Factor Lagging	Exciter Input kW	Station Service kW
18:00 - 18:05	117 433	70 484	117 148	0.8574	285	12 071
18:05 - 18:10	116 952	73 767	116 671	0.8458	281	12 117
18:10 - 18:15	117 779	72 126	117 488	0.8528	291	12 080
18:15 - 18:20	117 543	70 248	117 256	0.8584	287	12 058
18:20 - 18:25	116 421	70 952	116 136	0.8539	285	12 040
18:25 - 18:30	116 075	70 936	115 791	0.8533	284	11 995
18:30 - 18:35	116 167	71 986	115 884	0.8500	283	11 986
18:35 - 18:40	116 703	71 290	116 418	0.8534	285	11 996
Average	116 884	71 474	116 599	0.8531	285	12 043

ATIKOKAN TGS UNIT 1
TURBINE PERFORMANCE TEST NO 9
118 MW RUN 2

GENERATOR OUTPUT

Date Nov 20-1985 Time Period	Gen. Output Gross kW	Gen. Output Gross kVars	Gen. Output Net kW	Power Factor Lagging	Exciter Input kW	Station Service kW
22:15 - 22:20	117 796	74 847	117 504	0.8440	292	
22:20 - 22:25	118 900	73 615	118 609	0.8502	291	
22:25 - 22:30	119 588	72 362	119 300	0.8556	288	
22:30 - 22:35	119 824	72 463	119 535	0.8557	289	
22:35 - 22:40	119 128	72 185	118 840	0.8552	288	
22:40 - 22:45	119 369	72 050	119 081	0.8561	288	
22:45 - 22:50	119 681	71 560	119 394	0.8583	287	
22:50 - 22:55	119 752	71 429	119 465	0.8588	287	
22:55 - 23:00	119 698	72 948	119 408	0.8539	290	
23:00 - 23:05	119 790	73 590	119 499	0.8521	291	
23:05 - 23:10	119 677	73 573	119 386	0.8519	291	
23:10 - 23:15	119 698	74 147	119 406	0.8501	292	
Average	119 408	72 897	119 119	0.8535	289	

ATIKOKAN TGS UNIT 1
TURBINE PERFORMANCE TEST NO 10
TWO CONTROL VALVES FULL OPEN

GENERATOR OUTPUT

Date Nov 16-1985 Time Period	Gen. Output Gross kW	Gen. Output Gross kVars	Gen. Output Net kW	Power Factor Lagging	Exciter Input kW	Station Service kW
11:30 - 11:35	131 336	89 460	130 994	0.8265	342	
11:35 - 11:40	132 592	88 945	132 251	0.8305	341	
11:40 - 11:45	134 140	89 493	133 796	0.8319	344	
11:45 - 11:50	136 197	89 354	135 850	0.8361	347	
11:50 - 11:55	135 122	89 540	134 776	0.8336	346	
11:55 - 12:00	133 575	89 814	133 230	0.8299	345	
12:00 - 12:05	134 123	91 506	133 775	0.8261	348	
12:05 - 12:10	135 561	91 498	135 210	0.8289	351	
12:10 - 12:15	135 670	91 680	135 319	0.8285	351	
12:15 - 12:20	135 519	92 320	135 167	0.8265	352	
12:20 - 12:25	136 168	92 654	135 814	0.8268	354	
12:25 - 12:30	136 016	93 050	135 661	0.8253	355	
12:30 - 12:35	137 104	93 312	136 747	0.8267	357	
12:35 - 12:40	135 565	90 873	135 215	0.8306	350	
12:40 - 12:45	135 261	85 949	134 926	0.8440	335	
12:45 - 12:50	137 416	86 721	137 076	0.8457	340	
12:50 - 12:55	137 045	86 907	136 706	0.8445	339	
12:55 - 13:00	135 603	87 924	135 263	0.8391	340	
13:00 - 13:05	138 415	87 991	138 072	0.8439	343	
13:05 - 13:10	137 243	87 110	136 904	0.8443	339	
13:10 - 13:15	136 029	86 789	135 692	0.8430	337	
13:15 - 13:20	138 268	85 835	137 929	0.8496	339	
13:20 - 13:25	140 334	85 843	139 994	0.8531	340	
13:25 - 13:30	137 433	85 607	137 096	0.8488	337	
Average	135 906	89 174	135 561	0.8360	345	

accurac, data (cont.):

marked ratio and connection	burden	secondary amperes	ratio correction factor	phase angle minutes
5 : 5 (H_1H_2 - X_1X_2)	B 0.1	0.5	1.0002	+2.2
		1.0	1.0002	+1.9
		2.0	1.0002	+1.6
		3.0	1.0002	+1.4
		4.0	1.0002	+1.3
		5.0	1.0002	+1.3
	B 0.5	0.5	1.0003	+2.6
		1.0	1.0003	+2.2
		2.0	1.0003	+1.8
		3.0	1.0003	+1.6
		4.0	1.0003	+1.5
		5.0	1.0003	+1.4
	B 0.9	0.5	1.0005	+2.9
		1.0	1.0004	+2.4
		2.0	1.0004	+2.0
		3.0	1.0004	+1.8
		4.0	1.0004	+1.7
		5.0	1.0004	+1.5
	B 1.8	0.5	1.0007	+3.7
		1.0	1.0007	+3.0
		2.0	1.0006	+2.5
		3.0	1.0006	+2.2
		4.0	1.0006	+2.0
		5.0	1.0005	+1.8

The accuracy of this calibration is estimated to be within ±0.0003 in Ratio Correction Factor and ±1 minute in Phase Angle.

Approved: Certified: Tested:

G.L. Grant

R.D. Brown
Supervising Engineer
Electronics and
Instrumentation Sect
Electrical Research Dept

M. Sein
Supervising Technologist

G.L. Grant
Technologist

LLG:mh

Ontario Hydro
Research Division

Instrument Transformer Accuracy Record

type	Generator Current Transformer for Atikokan GS	serial no.	427331
nameplate data	Brown Boveri Current Transformer, Ratio 10 000/5/5 A, 60 Hz, accuracy 0.3 B 1.8		
received from	B.B. Howden Scarborough, Ontario	date received	June 15, 1983

accuracy data at 60 Hz

marked ratio and connection	burden	secondary amperes	ratio correction factor	phase angle minutes
10 000:5 (H_1H_2- X_1X_2)	B 0.1	0.5	1.0002	+2.2
		1.0	1.0002	+1.8
		2.0	1.0002	+1.5
		3.0	1.0002	+1.3
		4.0	1.0002	+1.2
		5.0	1.0002	+1.1
	B 0.5	0.5	1.0004	+2.5
		1.0	1.0003	+2.1
		2.0	1.0003	+1.7
		3.0	1.0003	+1.5
		4.0	1.0003	+1.4
		5.0	1.0003	+1.4
	B 0.9	0.5	1.0006	+2.9
		1.0	1.0005	+2.4
		2.0	1.0004	+2.1
		3.0	1.0004	+1.8
		4.0	1.0004	+1.7
		5.0	1.0004	+1.6
	B 1.8	0.5	1.0008	+3.7
		1.0	1.0007	+3.1
		2.0	1.0007	+2.6
		3.0	1.0006	+2.2
		4.0	1.0006	+2.1
		5.0	1.0006	+1.9

for terminology refer to CSA C13

job	file	date	record no.
740611-266-470	815.53	June 28, 1983	EC83-263-K

Ontario Hydro
Research Division

Instrument Transformer Accuracy Record

type	Generator Current Transformer for Atikokan GS	serial no. 427332
nameplate data	Brown Boveri Current Transformer, Ratio 10 000/5/5 A, 60 Hz, accuracy 0.3 B 1.8	
received from	B.B. Howden Scarborough, Ontario	date received June 15, 1983

accuracy data at 60 Hz

marked ratio and connection	burden	secondary amperes	ratio correction factor	phase angle minutes
10 000:5 (H_1H_2 - X_1X_2)	B 0.1	0.5	1.0003	+2.4
		1.0	1.0003	+1.9
		2.0	1.0002	+1.5
		3.0	1.0002	+1.2
		4.0	1.0002	+1.1
		5.0	1.0002	+1.1
	B 0.5	0.5	1.0004	+2.6
		1.0	1.0004	+2.1
		2.0	1.0004	+1.7
		3.0	1.0003	+1.5
		4.0	1.0003	+1.4
		5.0	1.0003	+1.2
	B 0.9	0.5	1.0006	+3.0
		1.0	1.0005	+2.4
		2.0	1.0005	+1.9
		3.0	1.0004	+1.6
		4.0	1.0004	+1.4
		5.0	1.0004	+1.3
	B 1.8	0.5	1.0009	+3.8
		1.0	1.0008	+3.2
		2.0	1.0007	+2.6
		3.0	1.0007	+2.3
		4.0	1.0006	+2.1
		5.0	1.0006	+1.9

for terminology refer to CSA C13

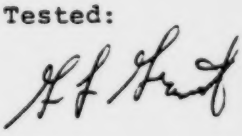
740611-266-470	815.53	June 30, 1983	EC83-264-K
job	file	date	record no.

accuracy data cont'd

marked ratio and connection	burden	secondary amperes	ratio correction factor	phase angle minutes
5:5 (T_1T_2 - X_1X_2)	B 0.1	0.5	1.0002	+2.4
		1.0	1.0002	+2.0
		2.0	1.0002	+1.6
		3.0	1.0002	+1.5
		4.0	1.0002	+1.4
		5.0	1.0002	+1.3
	B 0.5	0.5	1.0003	+2.8
		1.0	1.0003	+2.3
		2.0	1.0003	+1.9
		3.0	1.0003	+1.7
		4.0	1.0003	+1.6
		5.0	1.0003	+1.4
	B 0.9	0.5	1.0005	+3.2
		1.0	1.0004	+2.6
		2.0	1.0004	+2.1
		3.0	1.0004	+1.9
		4.0	1.0004	+1.7
		5.0	1.0004	+1.6
	B 1.8	0.5	1.0008	+4.0
		1.0	1.0007	+3.3
		2.0	1.0006	+2.6
		3.0	1.0006	+2.3
		4.0	1.0006	+2.1
		5.0	1.0006	+1.9

The accuracy of this calibration is estimated to be within ±0.0003 in Ratio Correction Factor and ±1 minute in Phase Angle.

Approved: Certified: Tested:



R.D. Brown
Supervising Engineer
Electronics & Instrumentation Section
Electrical Research Department

M. Sein
Supervising Technologist

G.L. Grant
Technologist

MS:GLG:rv

26112
rev. 76 05

Ontario Hydro
Research Division

Instrument Transformer Accuracy Record

type	serial no.
Generator Current Transformer for Atikokan GS	427333
nameplate data: Brown Boveri Current Transformer, Ratio 10 000/5/5 A, 60 Hz, accuracy 0.3 B 1.8	
received from: B.B. Howden Scarborough	date received: June 15, 1983

accuracy data at 60 Hz

marked ratio and connection	burden	secondary amperes	ratio correction factor	phase angle minutes
10 000:5 (H_1H_2 - X_1X_2)	B 0.1	0.5	1.0003	+2.2
		1.0	1.0003	+1.8
		2.0	1.0002	+1.5
		3.0	1.0002	+1.3
		4.0	1.0002	+1.2
		5.0	1.0002	+1.1
	B 0.5	0.5	1.0004	+2.6
		1.0	1.0004	+2.1
		2.0	1.0004	+1.7
		3.0	1.0003	+1.5
		4.0	1.0003	+1.3
		5.0	1.0003	+1.2
	B 0.9	0.5	1.0006	+3.1
		1.0	1.0005	+2.5
		2.0	1.0005	+1.9
		3.0	1.0004	+1.7
		4.0	1.0004	+1.5
		5.0	1.0004	+1.4
	B 1.8	0.5	1.0009	+3.9
		1.0	1.0008	+3.3
		2.0	1.0007	+2.4
		3.0	1.0006	+2.1
		4.0	1.0006	+1.8
		5.0	1.0006	+1.7

for terminology refer to CSA C13

job	file	date	record no.
740611-266-470	815.53	June 30, 1983	EC83-265-K

accuracy data (cont'd)

marked ratio and connection	burden	secondary amperes	ratio correction factor	phase angle minutes
5:5 ($T_1T_2 - X_1X_2$)	B 0.1	0.5	1.0003	+2.4
		1.0	1.0003	+2.0
		2.0	1.0003	+1.6
		3.0	1.0003	+1.5
		4.0	1.0003	+1.5
		5.0	1.0003	+1.3
	B 0.5	0.5	1.0004	+2.7
		1.0	1.0004	+2.3
		2.0	1.0004	+1.8
		3.0	1.0004	+1.6
		4.0	1.0004	+1.5
		5.0	1.0004	+1.4
	B 0.9	0.5	1.0006	+3.1
		1.0	1.0005	+2.6
		2.0	1.0005	+2.2
		3.0	1.0005	+1.8
		4.0	1.0005	+1.6
		5.0	1.0005	+1.5
	B 1.8	0.5	1.0009	+3.9
		1.0	1.0008	+3.1
		2.0	1.0007	+2.5
		3.0	1.0007	+2.2
		4.0	1.0007	+1.9
		5.0	1.0006	+1.7

The accuracy of this calibration is estimated to be within ±0.0003 in Ratio Correction Factor and ±1 minute in Phase Angle.

Approved: Certified: Tested:

G.L. Grant

R.D. Brown
Supervising Engineer
Electronics & Instrumentation Section
Electrical Research Department

M. Sein
Supervising Technologist

G.L. Grant
Technologist

MS:GLG:rv

for terminology refer to CSA C13

Instrument Transformer Accuracy Record

Generator Current Transformers

427332
427333

Nameplate data: Brown Boveri Current Transformer, Ratio 10 000/5/5 A, 60 Hz, Accuracy 0.3 B 1.8

Received from: Tested in situ at Atikokan GS Unit No 1

Date received: February 18, 1985

Relay data at 60 Hz

marked ratio and connection	burden (Z) *	secondary Amperes	ratio correction factor	phase angle minutes
		RED PHASE		
5 - 5 (T_1T_2- X_1X_2)	2.4 Ω	0.5	1.0007	+6.6
		1.0	1.0007	+5.5
		2.0	1.0007	+4.7
		3.0	1.0007	+4.0
		4.0	1.0006	+3.7
		5.0	1.0006	+3.6
		WHITE PHASE		
5 - 5 (T_1T_2 - X_1X_2)	2.1 Ω	0.5	1.0008	+7.8
		1.0	1.0008	+6.8
		2.0	1.0008	+5.5
		3.0	1.0008	+5.0
		4.0	1.0008	+4.3
		5.0	1.0008	+4.1
		BLUE PHASE		
5 - 5 (T_1T_2- X_1X_2)	2.4 Ω	0.5	1.0009	+6.8
		1.0	1.0008	+5.8
		2.0	1.0008	+4.6
		3.0	1.0008	+4.0
		4.0	1.0008	+3.7
		5.0	1.0008	+3.3

* The burden connected to each transformer was the normal station burden (measured single phase).

The accuracy of this calibration is estimated to be ±0.0005 in Ratio Correction Factor and ±2 minutes in phase angle.

Approved:
R.D. Brown
Electronics and Instrumentation Section
Electrical Research Department

Certified:
M. Sein
Supervising Technologist

Tested:
G.L. Grant
Technologist

740611-262-407	815.53	March 5, 1985	EC85-82-K
job	file	date	record no.

Instrument Transformer Accuracy Record

Voltage Transformer	530307
nameplate data: Canadian General Electric, Instrument Voltage Transformer, Type E-235Y, 60 cycles, accuracy 0.3 Z	
received from: System Studies Section	date received: July 16, 1984

accuracy data at 60 Hz

marked ratio and connection	burden	secondary (volts)	ratio correction factor	phase angle minutes
90:1	zero	120	0.9984	-0.3
	A*		0.9988	-2.8
	B*		0.9984	-0.3
	C*		0.9984	-0.3
120:1	zero	108-132	0.9987	-0.5
	A*		0.9991	-3.6
	B*		0.9987	-0.5
240:1	zero	100	0.9984	-0.2
	A*		0.9987	-1.5

*Burden A was 40.3 V·A, 1.0 pf at 120 V (357.7 Ω)

Burden B was one voltage circuit of a SC Digilogic watthour transducer and one voltage circuit of a Sangamo VAD 3-element transformer. The output of the VAD transformer was connected to another Digilogic watthour transducer.

Burden C was Burden B and a current limiting fuse (4 Ω) in the primary and a 6 A fuse in the secondary circuit.

The accuracy of this calibration is estimated to be ±0.0003 in Ratio Correction Factor and ±1 minute in Phase Angle.

Approved:	Certified:	Tested:
R.D. Brown	M. Sein	G.L. Grant
Supervising Engineer	Supervising Technologist	Technologist

for terminology refer to CSA C13

job	file	date	record no.
740618-504-022	815.51	August 7, 1984	EC84-299-K

Instrument Transformer Accuracy Record

type		
	Voltage Transformer	530308
nameplate data	Canadian General Electric, Instrument Voltage Transformer, Type E-235Y, 60 cycles, accuracy 0.3 Z	
received from	System Studies Section	date received: July 16, 1984

accuracy data at 60 Hz

marked ratio and connection	burden	secondary (volts)	ratio correction factor	phase angle minutes
90:1	zero	120	0.9984	-0.3
	A*		0.9988	-2.9
	B*		0.9984	-0.3
	C*		0.9984	-0.3
120:1	zero	108 - 132	0.9986	-0.5
	A*		0.9991	-3.6
	B*		0.9987	-0.5
240:1	zero	100	0.9984	-0.3
	A*		0.9987	-1.6

*Burden A was 40.3 V·A, 1.0 pf at 120 V (357.7 Ω)

Burden B was one voltage circuit of a SC Digilogic watthour transducer and one voltage circuit of a Sangamo VAD 3-element transformer. The output of the VAD transformer was connected to another Digilogic watthour transducer.

Burden C was Burden B and a current limiting fuse (4 Ω) in the primary, and a 6 A fuse in the secondary circuit.

The accuracy of this calibration is estimated to be ±0.0003 in Ratio Correction Factor and ±1 minute in Phase Angle.

Approved:	Certified:	Tested:
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Supervising Engineer	Supervising Technologist	Technologist

for terminology refer to CSA C13

86-31

job	file	date	record no.
740618-504-022	815.51	August 7, 1984	EC84-300-K

Instrument Transformer Accuracy Record

Voltage Transformer	serial no. 530309
nameplate data: Canadian General Electric, Instrument Voltage Transformer, Type E-235Y, 60 cycles, accuracy 0.3 Z	
received from: System Studies Section	date received: July 16, 1984

accuracy data at 60 Hz

marked ratio and connection	burden	secondary (volts)	ratio correction factor	phase angle minutes
90:1	zero	120	0.9984	-0.3
	A*		0.9988	-2.8
	B*		0.9984	-0.3
	C*		0.9983	-0.3
120:1	zero	108-132	0.9986	-0.5
	A*		0.9991	-3.5
	B*		0.9987	-0.4
240:1	zero	100	0.9984	-0.2
	A*		0.9986	-1.5

*Burden A was 40.3 V·A, 1.0 pf at 120 V (357.7 Ω)

Burden B was one voltage circuit of a SC Digilogic watthour transducer and one voltage circuit of a Sangamo VAD 3-element transformer. The output of the VAD transformer was connected to another Digilogic watthour transducer.

Burden C was Burden B and a current limiting fuse (4 Ω) in the primary and a 6 A fuse in the secondary circuit.

The accuracy of this calibration is estimated to be ±0.0003 in Ratio Correction Factor and ±1 minute in Phase Angle.

Approved:	Certified:	Tested:
R.D. Brown	M. Sein	G.L. Grant
Supervising Engineer	Supervising Technologist	Technologist

for terminology refer to CSA C13

740618-504-022 job	815.51 file	August 7, 1984 date	EC84-301-K record no.

ontario hydro
research division

To Mr. I.J. Stuart-Sheppard
Manager, Power Equipment Dept
Design & Development Division - Generation
H11A27

INSTRUMENT TRANSFORMER CORRECTION FACTORS FOR PERFORMANCE TESTS ON UNIT NO 1, ATIKOKAN GS

G.L. Grant

Instrument Transformer Correction Factors (ITCF) have been calculated for the metering configuration used during performance tests on Unit No 1 at Atikokan GS.

The ratio of the generator current transformers (ct) was 10,000 - 5-5 A and that of the voltage transformers (vt), specially installed for the tests, was 10.8 kV - 120 V, (90:1).

The ct were calibrated on site in March 1985 by utilizing the 5 to 5 A test primary. Prior to installation these transformers were calibrated in the Research Laboratory on the 10,000 - 5 A ratio (one turn primary) and the 5 to 5 A ratio (test primary).

A comparison of the measurements made at the laboratory and the field calibration show no significant change in the transformer errors.

The three vt used during the performance tests were calibrated in the Research Laboratory before being shipped to Atikokan GS.

The nameplate data and the calibration report numbers for the transformers are listed in Appendix 1.

The ITCFs listed are directly applicable only to the three - phase three element energy measurements made during performance tests, and are to be applied at the terminals of the watthour transducer.

job	file	date	report no.
740611-262-401	815.53	December 20, 1985	EC85-483-K

Secondary Current (A)	Secondary Voltage (V)	Power Factor (Lagging)	Instrument Transformer Correction Factor (ITCF)
1.5	120	0.99	0.9989
2.0		0.85	0.9982
2.5		0.85	0.9982
2.5		0.95	0.9986
3.5		0.85	0.9983
3.75		0.85	0.9982
4.0		0.85	0.9983
4.0		0.95	0.9986

The accuracy of the ITCF is estimated to be +/-0.0010.

Approved:

for R.D. Brown
Supervising Engineer
Electronics & Instrumentation Section
Electrical Research Department

Submitted:

G.L. Grant
Technologist
Electronics & Instrumentation Section

DISTRIBUTION

Mr. I.J. Stuart-Sheppard	Design & Development - Gen, H11A27
Mr. D.C. Lee	Electrical Research, KR130
Mr. G.L. Grant	Electrical Research, KR119

APPENDIX 1

NAMEPLATE DATA

Current Transformers (3)

Brown Boveri
AKG10ACQ
Ratio 10,000/5/5 A
Accy 0.3 B 1.8
Serial #427331
Serial #427332
Serial #427333

Voltage Transformers (3)

Canadian General Electric
Type E-235Y
Ratio 240/200/180/160/140/120/100/90/80/70/60 to 1
Serial #1091790
Serial #1091791
Serial #1091792

Calibration Reports

Voltage Transformers:	EC84-299-K
	EC84-300-K
	EC84-301-K
Current Transformers:	EC83-263-K
	EC83-264-K
	EC83-265-K
	EC85-82-K

Mr. D.F. Townshend
System Studies Section
Research Division

Watt/Watthour Transducer	serial no Lab No 3788

nameplate data: Scientific Columbus Watt/Watthour Standard
Model DL34-2K5-A2-6070 5A 120V 60Hz 1500W
3 element 3 phase 4 wire 1 mA dc into 0 to 10 kohm

received from System Studies Section	date received October 31, 1985

Calibration by Standard Watthour Meter (SC1) on Balanced
Three Phase Load 116 V Phase to Phase 60 Hz
Ambient Temperature 23 C

Test Current (Amperes)	Power Factor	Percentage Registration
0.25	1.0	99.82
0.8	1.0	99.87
2.0	1.0	99.88
2.25	1.0	99.88
2.65	1.0	99.89
3.3	1.0	99.89
3.95	1.0	99.89

The transducer was connected 2 element (red & blue) 3 phase.

The percentage registration was based on the digital readout and the time set by the internal interval timer.

The accuracy of the calibration is estimated to be ±0.1 percentage registration.

Approved:	Certified:	Tested:
R.D. Brown	M. Sein	G.L. Grant
Supervising Engineer	Supervising Technologist	Technologist

standards laboratory - electronics and instrumentation section - electrical research department

next calibration scheduled for:	file	date	report no.
	815.11(P)	November 5, 1985	EC85-418-K

Ontario Hydro Research Division

instrument calibration report

to	Mr. D.F. Townshend System Studies Section Research Division
instrument	Watt/Watthour Transducer
serial no.	Lab No 3788
nameplate data	Scientific Columbus Watt/Watthour Standard Model DL34-2K5-A2-6070 5A 120V 60Hz 1500W 3 element 3 phase 4 wire 1 mA dc into 0 to 10 kohm
received from	System Studies Section
date received	December 5, 1985

Calibration by Standard Watthour Meter (SC1) on Balanced
Three Phase Load 120 V Phase to Neutral 60 Hz
Ambient Temperature 23 C

Test Current (Amperes)	Power Factor (Lagging)	Percentage Registration
1.5	0.99	99.88
2.0	0.85	99.87
2.5	0.85	99.87
2.5	0.95	99.88
3.5	0.85	99.87
3.75	0.85	99.87
4.0	0.85	99.87
4.0	0.95	99.88

The transducer was connected 3 phase, 3 element, 4 wire.

The percentage registration was based on the digital readout and the time set by the internal interval timer.

The accuracy of the calibration is estimated to be ±0.1 percentage registration.

Approved:	Certified:	Tested:
R.D. Brown	M. Sein	G.L. Grant
Supervising Engineer	Supervissng Technologist	Technologist

standards laboratory - electronics and instrumentation section - electrical research department

next calibration scheduled for:	file	date	report no.
	815.11(P)	December 10, 1985	EC85-485-K

to: Mr. D.F. Townshend
System Studies Section
Research Division

instrument: Watt/Watthour Transducer
Phase Shifting Transformer

lab no: Lab No 3961
6392338

nameplate data: 1. Watt/Watthour Transducer
1500 Watts = 1500 MW, 1 contact transfer = 1 watt hour
2. VAD Transformer, Volts 120/208, Cycles 60, compensated for 7.5 VA burden

received from: System Studies Section

date received: October 29, 1985

Calibration by Standard Varmeter on Balanced
Three Phase Load, 120 V Phase to Neutral, 60 Hz
Ambient Temperature 23°C

Test Current (Amperes)	Power Factor lag	Percentage Registration
1	0.9	99.7
2		99.7
3		99.8
4		99.8
5		99.8

The watthour transducer was connected to the VAD transformer and was calibrated as a varhour meter.

The percentage registration was based on the digital readout and the time set by the internal interval timer.

The accuracy of the calibration is estimated to be ±0.1 percentage registration.

Approved:

R.D. Brown
Supervising Engineer

Certified:

M. Sein
Supervising Technologist

Tested:

G.L. Grant
Technologist

standards laboratory - electronics and instrumentation section - electrical research department

next calibration scheduled for:	file: 815.11(P)	date: November 5, 1985	report no.: EC85-416-K

Mr. D.F. Townshend
System Studies Section
Research Division

Watt/Watthour Transducer — Lab No 3961
Phase Shifting Transformer — serial no. 6392338

data 1. Watt/Watthour Transducer
1500 Watts = 1500 MV, 1 contact transfer = 1 watt hour
2. VAD Transformer, Volts 120/208, Cycles 60, compensated for 7.5 VA burden

received from: System Studies Section — date received: December 5, 1985

Calibration by Standard Varmeter on Balanced
Three Phase Load, 120 V Phase to Neutral, 60 Hz
Ambient Temperature 23°C

Test Current (Amperes)	Power Factor (Lagging)	Percentage Registration
1.5	0.99	99.8
2.0	0.85	99.8
2.5	0.85	99.8
2.5	0.95	99.8
3.5	0.85	99.8
3.75	0.85	99.8
4.0	0.85	99.8
4.0	0.95	99.8

The watthour transducer was connected to the VAD transformer and was calibrated as a varhour meter.

The percentage registration was based on the digital readout and the time set by the internal interval timer.

The accuracy of the calibration is estimated to be ±0.1 percentage registration.

Approved:	Certified:	Tested:
R.D. Brown	M. Sein	G.L. Grant
Supervising Engineer	Supervising Technologist	Technologist

standards laboratory - electronics and instrumentation section - electrical research department

next calibration scheduled for:	file	date	report no.
	815.11(P).	December 6, 1985	EC85-484-K

Mr. D.F. Townshend
System Studies Section
Research Division

Watt/Watthour Transducer | serial no. 6180

Watt/Watthour Transducer, 3 phase, 4 wire, 5 A, 120 V
1500 Watts = 1500 MV, 1 contact transfer = 1 Watt Hour

received from System Studies Section | date received October 31, 1985

Calibration by Standard Watthour Meter (SC1) on Single Phase Load at 120 V, 60 Hz
Ambient Temperature 23°C

Test Current (Amperes)	Power Factor	Percentage Registration
1	1.0	100.11
2		100.11
3		100.11
4		100.10
5		100.10
5	0.5 lg	100.10

For this calibration the three voltage circuits were connected in parallel and the three current circuits were connected in series.

The percentage registration was based on the digital readout and the time set by the internal interval timer.

The accuracy of the calibration is estimated to be ±0.1 percentage registration.

Approved:

R.D. Brown
Supervising Engineer

Certified:

G.L. Grant
Technologist

Tested:

M. Valcic
Technician

standards laboratory - electronics and instrumentation section - electrical research department

next calibration scheduled for:	file 815.11(P)	date November 5, 1985	report no. EC85-428-K

to: Mr. D.F. Townshend
System Studies Section
Research Division

instrument	serial no.
Watt/Watthour Transducer	6180 Lab No 4309

nameplate data: Watt/Watthour Transducer, 3 phase, 4 wire, 5 A, 120 V
1500 Watts = 1500 MV, 1 contact transfer = 1 watt hour

received from	date received
System Studies Section	December 5, 1985

Calibration by Standard Watthour Meter (SC1) on
Balanced Three Phase Load at 120 V, 60 Hz
Ambient Temperature 23°C

Test Current (Amperes)	Power Factor	Percentage Registration
0.5	1.0	100.2
1.0	1.0	100.1
0.5	0.5 lag	100.4
1.0	0.5 lag	100.4
0.5	0.3 lag	100.5
1.0	0.3 lag	100.5

The transducer was connected 3-phase, 2-element (red and blue) and the auxiliary supply was energized at 120 V.

The percentage registration was based on the time set by the internal timer, and the digital readout.

The accuracy of the calibration is estimated to be ±0.1 percentage registration at 1.0 power factor and ±0.25 percentage registration at 0.5 and 0.3 lagging power factor.

Approved:	Certified:	Tested:
for R.D. Brown Supervising Engineer	M. Sein Supervising Technologist	G.L. Grant Technologist

standards laboratory - electronics and instrumentation section - electrical research department

next calibration scheduled for:	file	date	report no.
-	815.412(P).	December 19, 1985	EC85-486-K

to Mr. D.F. Townshend
System Studies Section
Research Division

Watt/Watthour Transducer | 6176

Watt/Watthour Transducer, 3 phase, 4 wire, 5 A, 120 V
1500 Watts = 1500 MV, 1 contact transfer = 1 Watt hour

received from System Studies Section | date received October 31, 1985

Calibration by Standard Watthour Meter (SC1) on Single Phase Load at 120 V, 60 Hz
Ambient Temperature 23°C

Test Current (Amperes)	Power Factor	Percentage Registration
1	1.0	100.13
2		100.12
3		100.13
4		100.12
5		100.12
5	0.5 lg	100.10

For this calibration the three voltage circuits were connected in parallel and the three current circuits were connected in series.

The percentage registration was based on the digital readout and the time set by the internal interval timer.

The accuracy of the calibration is estimated to be ±0.1 percentage registration.

Approved:

R.D. Brown
Supervising Engineer

Certified:

G.L. Grant
Technologist

Tested:

M. Valcic
Technician

standards laboratory - electronics and instrumentation section - electrical research department

next calibration scheduled for:	file 815.11(P)	date November 5, 1985	report no. EC85-427-K